

**It's Not Just Soldiering in a Hotter Environment: Less
Discussed Issues of Global Warming Relevant to Military
Operations in Africa**

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Introduction

Global warming - whether anthropogenic in nature or not - according to many scientists is no longer a prediction...it's here.¹ The forecast is for even hotter temperatures, but what is the forecast for where global warming will have its greatest impact, a continent without the resources to mitigate the effects of the temperature rise, a continent with a long history of conflict, and a continent with valuable resources including some which are critical to electronics, jet engines, and other advanced technologies of the modern world? With some predicting global warming will result in even more conflict, another important question is being asked, what are the implications of military operations as the mercury climbs in that part of the world only a few hours by plane from the United States? In other words, with global warming bumping up the temperature, what will be the potential causes of the conflicts, and if the US intervenes, what will it be like to fight there, far away...in Africa?

Numerous papers have already been written about many of the effects global warming will have on military operations, conflicts, or both. Most of these deal with the immediate effects of the heat, such as the rise in sea level as polar ice melts, inundating some islands. Others discuss the massive displacements of people that might occur as they search for fertile farmland, their previous small plots having been baked by the sun, and the likelihood these migrations will result in war. Public health physicians note the increase in available territory for mosquitoes, allowing malaria to spread to regions where it was previously unknown, weakening farmer and soldier alike. These are all incredibly important aspects of global warming related to conflict and military operations, but there are other aspects to this story that are less often told. There will be massive economic

losses not just from crop losses but also from destruction of areas popular with ecotourists, with the result that significantly less money will be available for African defense forces. Diseases won't just come from spreading the mosquitoes range but from the increasing preparation and consumption of bushmeat, such as the great apes, as people driven from their arid farmlands invade forests looking for food. Ebola is one such disease, a disease whose very name the press has made almost synonymous with "terrifying." These and other less discussed issues related to the impact of global warming on military operations in Africa will be explored by this paper.

With global warming appearing to already be making physical changes in Africa, it behooves any nation which might become militarily involved there to look at all aspects of known changes - physical, economic, social, and political - and to vigorously search for any that might have been overlooked. It's also necessary to examine how these rising temperatures could possibly cause additional conflicts. Yet another area of study needs to be global warming's impact on the operations of a nation's armed forces should it actually decide to intervene in Africa. The US, with both humanitarian and economic interests there, might someday be one of those intervening nations.

The main controversy surrounding global warming does not seem to be whether or not it is occurring, though to be sure there are some who argue against its existence. The larger controversy, however, appears to be whether or not the cause is anthropogenic. It would be beyond the scope of this paper to argue for or against human activity causing a rise in atmospheric temperature. The majority of scientists support the theory, but heated battles, pun intended, continue to rage. For some the evidence seems solid and overwhelming, for others weak and unimpressive. Other theories have been put forth to

explain possible temperature changes, including variations in the solar constant, which despite its name is not constant. Complicating the issue is the addition of politics, economics, and even religious beliefs thrown into the mix. However, for this paper global warming will be accepted as actually occurring, whether caused by natural and/or human forces, and readers are encouraged to examine the controversy in much greater detail in other papers.

Additionally, as a result of this acceptance of global warming, the paper will attempt to extrapolate key findings out to the future, with all of the potential problems that entails. Projections will utilize models incorporating information from the past, but as the prospectus for a stock sale reads, past performance is no indicator of future performance. However, these models, along with what appear right now to be fairly reasonable assumptions, will necessarily have to serve as the basis for the projections. Meanwhile, the present indicators for how global warming will impact Africa are ominous, and how global warming unfolds and its effect on Africa, including possible future military operations there, remains a story waiting to be told.

Global Warming: the Basics

Global warming, sometimes referred to as global climate change, is the rise in temperature many say has already begun and predict will continue for years to come. For some it is an accepted fact, for others not so much. The most controversial component of global climate change is how much of it is caused by human activity, or in scientific jargon, anthropogenic. The theory behind human caused global warming is that as fossil fuels are burned they release carbon dioxide and other gases.² The sun's rays pass through

the atmosphere, heating the earth, which in turn emits infrared radiation. Carbon dioxide and certain other gases absorb a portion of that infrared radiation and reradiate it back toward earth, causing the temperature in the lower atmosphere to increase. Infrared radiation outbound from the earth that was not absorbed and reradiated heads off toward space. As the amount of carbon dioxide in the atmosphere increases more infrared radiation, and hence heat, is trapped in the lower atmosphere. At the risk of oversimplifying even further, the process is similar to the way glass panes in a greenhouse allow the sun's rays in but then trap the heat they create inside. Thus, gases such as carbon dioxide which act to trap the heat are called greenhouse gases. As the temperature rises we have the greenhouse effect.³

Based on computer models the Intergovernmental Panel on Climate Change, in their 2007 Fourth Assessment Report, estimated global surface temperature will likely rise by 1.1 to 6.4 °C (2.0 to 11.5 °F).⁴ This increase can be broken down into two components, that directly attributable to the increase in carbon dioxide in the atmosphere and that which occurs indirectly. The first part, the directly attributable, seems to have general support among the public, probably in part because the science is fairly straightforward and the percentage of the estimated overall total rise is not so great. It's the second part where the most disagreement appears to be occurring. The indirectly attributable rise in temperature, basically secondary effects due to the increase in carbon dioxide, can best be explained by looking at an example, of which permafrost is perhaps one of the best. As global temperature rises from the increase in carbon dioxide, permafrost will start to melt. Permafrost, defined as soil at or below water's freezing point for two or more years, contains large quantities of methane, a greenhouse gas. When the permafrost starts to

melt, methane is released.⁵ As permafrost also contains large amounts of biomass, warming allows natural chemical processes to occur that previously had been stopped by the freezing temperatures, so the biomass rots and produces more methane.⁶

The permafrost example can also serve to explain the concept of a tipping point beyond which there is a sudden acceleration of the process that is essentially uncontrollable. Those who are familiar with science will recognize the following example as a positive feedback cycle. Permafrost defrosts, releases methane into the atmosphere, further warming the atmosphere, causing further release of methane, and so forth. Eventually it cascades to where no amount of intervention can stop all of the permafrost from melting.

Two final notes need to be stated regarding the physical effects global warming. First, it's not going to impact every location the same way. Some regions will see less rainfall whereas others will experience more.⁷ A corollary to this is that some regions will probably actually benefit from global warming, though for much of Africa the net effect will probably be a loss. Second, global warming will cause more instances of extreme weather.⁸ As an example, with water temperature increasing, more and stronger hurricanes may form.

In the end global warming implies more than just the air getting warmer; numerous changes will occur - physical, economic, social, - that will alter societies, including their militaries. Those changes might be greatest in Africa, a continent that generally does not have the financial or technical resources to deal with many older problems such as hunger, disease, and interminable wars, let alone a new one, a rise in the temperature.

Reactive Versus Proactive

Perhaps the most serious problem that will be associated with global warming's impact on military operations is the probability the American military's stance overall will be reactive versus proactive. This is not to say the American military has not shown some proactive movements in this area; indeed this paper itself, sponsored by a military organization, is proof of a desire to at least study potential impacts of global warming on military operations. However, there are several factors acting against a more proactive stance in Africa. These include the following:

- Though from a geologic perspective where change is measured in millions of years, the alterations to the earth by global warming are incredibly rapid, from a human perspective they are so incremental as to be imperceptible to many people, especially those in richer countries. That brings us to the next point:
- Most of the larger impacts of global warming are occurring in Africa whereas American foreign policy is, for the most part, developed in the US. The expression "out of sight, out of mind" is perhaps an appropriate one in this instance.
- Many people don't see a relationship between global warming and changes in military operations, or feel it's not significant enough, especially at this time, to warrant action.
- Compared to modernization of the force, retention of experienced soldiers and many other issues, global warming's impact on military operations in Africa is a relatively low priority for the American military.

- Perhaps the question isn't "what will be the impact of global warming on military operations in Africa" but rather "who cares?" This last remark might be perceived as overly callous, but the truth is there is little appetite right now for American intervention in yet another foreign land. If anything, the opposite is true; America will probably contract its foreign commitments.
- It's not just the American spirit that's been drained by the wars in Afghanistan and Iraq. The toll on the American military, both in lives and money, has been enormous. It's likely the issue of how military operations in Africa will change with global warming will fall toward the bottom of the list of what to do with limited resources.

Why then should the United States be proactive with regards to global climate change and military operations in Africa? Just as there are several reasons for American reactivity, there are also several to be proactive. These include

- What happens in Africa to an extent will be a harbinger of things to come in other lands. By examining how conflicts are fought as the temperature climbs there, and how to adjust to those temperature changes, the military can learn valuable lessons for future conflicts in other regions of the world. This is not to say America wants to see war on that continent. Lessons on how to use the military to keep the peace as the temperature climbs could be even more valuable.
- America depends on critical resources from Africa such as rare earth elements and oil.⁹ Should the sources of these be threatened it might be necessary to militarily intervene.

- Terrorist organizations in Africa have a global reach.¹⁰ America and its African allies must be capable of militarily counteracting this threat on African soil no matter what the physical environment.
- Global interconnectedness means what happens in Africa does not necessarily stay in Africa. Thanks to jet travel, diseases related to global warming which impact African militaries can be expected to quickly jump the Atlantic and impact American soldiers situated on US domestic bases.

Though several reasons have been listed for both sides of the reactive versus proactive issue regarding how military operations in Africa will change with the increasing temperature, this author believes the military posture will lean more towards reactive. It is not that the US military lacks the will. It is not that the US military is shortsighted. Indeed, the American military is always capable of being forceful and at times also quite visionary. The problem is the military is preoccupied elsewhere, and only limited resources will be available to tackle this issue.

A Change in Maritime Borders?

Though much has been said about the melting of ice in the polar regions and the scramble of Russia, Canada, and others to claim mineral rich undersea areas as their own, regions previously of little commercial value as the ice coverage made exploitation of the deposits economically infeasible, little has been mentioned of the reverse effect, nations potentially losing their claims to economically important coastal areas because of global warming. Thus, while the northern ice melts, allowing commercially viable drilling and

mining to take place, in the more southern latitudes the rising sea level threatens to alter maritime claims to rich fishing grounds, oil and gas deposits, and other valuable commodities.

As some maritime boundaries are based on geographic features, a change in water level could significantly alter what was previously thought to belong to a nation. As an example, consider a nation's territorial waters, which, as defined by the 1982 United Nations Convention on the Law of the Sea, extend no more than 12 nautical miles (22 kilometers, 14 miles) from the baseline, usually defined as the mean low-water mark.¹¹ Military and civilian ships as well as planes transiting past those 12 nautical miles are allowed innocent passage.¹² Should an island nation become partially submerged, other nations might consider the territorial waters to have moved, potentially resulting in conflict as countries argue what the new borders should be. The situation could be aggravated if claims to mineral and other resources are involved. Except when there is less than 400 nautical miles between two countries, exclusive economic zones are 200 nautical miles from the baseline.¹³ Move the baseline and suddenly rich oil deposits previously claimed by one country may now be in international waters. Should an island that is part of an archipelago nation disappear, or perhaps even an entire island nation be wiped from the map as its last vestige is covered by water, dramatic changes in what constitutes international waters could result. Previously off-limits resources might now be made available to both allies and enemies of the United States.

Could an about to be submerged island nation sell the mineral rights to territorial waters it soon will no longer have? What about the minerals on the island itself; who do they belong to when there is no more island? Can there be a government in absentia of an

island nation if the nation is no longer on the map? Does an international body such as the United Nations decide and what happens if nations disagree with the rulings? Potentially the military implications are extremely significant. It is as if the bygone days of England, France, Portugal, and others setting sail to discover new places, clashing over competing claims, are reoccurring with a new set of actors and a new set of opportunities but the same nationalism that could lead to war. A US military fleet sailing into such disputed waters could find itself most unwelcome.

China's Increases Its Hold

China, which already surpasses the United States for investment in Africa, will probably benefit from the impact of global warming of the African continent.¹⁴ Numerous ways exist for this to occur, many of them at the expense of America and all of them involving an increased likelihood of Chinese citizens potentially being present in future areas of conflict. That's a condition which could greatly complicate American military operations, including the situation dependent possibilities ranging from China opposing US actions all the way up to China wanting to participate in them. A closer look at probable future Chinese involvement in Africa will show just how its already close ties with Africa will grow even further.

First, Chinese companies will probably sell significantly more green technology, such as solar panels and hydroelectric dams, to Africa compared to America. This will make China's footprint on the continent even larger. Second, China will probably serve as a lender for some of the green projects, involving financial transactions which will tie African nations closer to the Chinese. Third, the Chinese will probably increase their

purchases of rare earth elements and other materials from Africa in order to construct the solar panels, windmills, and other green technologies the Africans are buying. There might even be some deals in place where China purchases the raw materials for a discount from the same country it will sell solar panels to for a discount.

In other words, expect an increased Chinese presence in Africa because of global warming. Some of their purchases and sales will be enormous, and they will be protective of these transactions, threatening to use force if necessary. America, in not having invested in research and development in alternative technologies the way the Chinese have, not having the manufacturing base the Chinese have, not having the lending power the Chinese have, and already being late to the game, might find itself increasingly marginalized in Africa.¹⁵

Loss of Ecotourism Revenue Leads to a Decrease in Defense Expenditures

The economic ramifications which might impact American military operations in Africa are enormous. Decreased revenues within African nations mean many countries, already diverting significant funds to attempt to mitigate the impact of global warming, will have less money to spend on defense. Thus, we may find our African allies with fewer troops, older equipment, and less experience as they could not afford to train as much as they had prior to their loss of defense dollars.

Regarding the loss of revenue in African nations, much has been written regarding how global warming will result in a decrease in African crops which in turn will result in decreased financial revenue. However, it's important for the reader to keep in mind that while there will certainly be a decrease in agricultural exports, most food in Africa is

raised for local consumption. Therefore, while a drop in total food production may have devastating effects on the population, much of the impact will not be related to the loss of revenue from food exports.

One area generally overlooked regarding revenue production which most likely will be impacted by climate change is ecotourism. As stated elsewhere in this paper, as viable agricultural land is lost to global warming, indigenous people will turn to the protected wildlife preserves for farming and hunting. Tourists spend large amounts of money every year to visit Africa, especially to see what are commonly referred to as the big five: lions, elephants, Cape buffalo, leopards, and rhinoceroses. Safaris frequently advertise the likelihood of seeing one or more of these. Foreigners with badly needed hard currency might find somewhere else to go if a site which previously boasted of these animals is now without them.

Should violence increase in Africa as people fight over scarcer resources, it too will keep visitors away. The mountain gorillas of Rwanda are majestic, but the genocide that occurred there in 1994 still keeps some potential tourists from visiting.

The formula is simple. Fewer animals mean fewer ecotourists which means less revenue. That translates into fewer defense dollars and fewer soldiers. This in turn means fewer people to guard the national parks, which means increased poaching of protected species as well as deforestation for growing crops. The cycle is complete as this means fewer animals. It only ends when there are no animals, then the number of ecotourists drops to zero. Few if any will pay large amounts of money to see a place where herds of mighty animals once roamed but is now desolate of wildlife, perhaps smelling of smoke, the remnant of slash and burn agriculture used to clear the land.

Less Discussed Health Problems

Much has been discussed about insects able to populate new areas which previously had been too cold for them to survive. Thus, malaria, dengue and other insect-borne diseases are spreading, a problem which will necessitate diverting military resources from actual combat operations should an army find itself in one of the newly infested areas.

There are, however, additional potential health problems from global warming discussed far less frequently than those related to the spread of mosquitoes and other insects yet possibly just as troublesome from a military standpoint. These include sewage, increased dust, zoonotic diseases from preparation and consumption of bushmeat, and the potential adverse effects of taking antimalarials. These will be discussed in the following paragraphs, beginning with sewage.

Less developed nations often have older, poorly maintained sewage disposal and treatment capabilities. Any additional burden on those antiquated dilapidated systems may cause them to fail. With changes in weather patterns, increased flooding in some areas is likely as parched areas are suddenly inundated with water, resulting in massive runoffs which could reach sewers, with disastrous results for the old pipes. As for those nations which discharge waste into the ocean, they may find coastal flooding wrecking havoc on their sewage disposal process.

Proper sewage disposal and treatment is a great deal more than just removing unpleasant odors, though the author has been to an island off the coast of Africa following flooding and can testify the stench from untreated sewage can be a strongly negative work environment factor. The main problem with untreated sewage is it can be a source of disease, especially if it contaminates drinking water supplies.

Although proper sanitation procedures and prophylactic medical care may prevent most water-borne illnesses from breaking out among American troops stationed in a less developed country where flash flooding just occurred, the local populace may succumb to the disease, making American aid efforts that more difficult. Additionally, if local soldiers were supposed to serve as allies of the Americans in joint military ventures, they may be decimated by an outbreak, leaving the Americans alone to carry on. As for amphibious landings, these may have to be altered when the beaches are covered in sewage.

Aggravating the situation is the warm weather as the bacteria, viruses, and protozoa which cause water-borne illnesses can reproduce quicker at higher temperatures. More pathogenic microbes generally translates into more trouble.

Some of the water-borne diseases which may be of military operational concern include:

- Cholera
- Amoebiasis
- Giardiasis
- Botulism – soldiers may not realize that cleaning a wound with botulism contaminated drinking water can introduce the microbe into the body, leading to death if not treated in time.
- Dysentery
- Salmonellosis¹⁶

The problems with diseases caused by microbes don't end with those which are water-borne and insect-borne. Global warming will probably also see an increase in the number of fungal infections among troops serving in Africa; a continent so hot that these diseases are already fairly common. Fungi like warm, moist areas, such as sweaty body parts, so with a rise in ambient temperature a concomitant increase in fungal diseases can be expected. Though a few can be serious, even life threatening, most diseases caused by fungi are more of an annoyance, such as ringworm, which is not a worm at all but rather a fungal infection of the skin. Athlete's foot, *tinea pedis*, is caused by fungi.¹⁷ Athlete's foot might not be a showstopper when it comes to military ops, but it and the other superficial fungal skin infections can hinder troop effectiveness. Additionally, it means adding weight to rucksacks if soldiers need to carry the necessary medicines to counteract these diseases.

Finally, in the discussion of diseases likely to increase with global warming which will impact military operations, are those caused by increased contact with wild animals as well as their preparation and consumption. The loss of viable agricultural land will result in more slash and burn agriculture of virgin lands, including poorly protected wildlife preserves harboring endangered animals such as large primates. Additionally, poaching and consumption of bushmeat will likely increase as a rising population confronts food shortages. This increased human contact with wildlife will probably lead to an increase in zoonotic diseases. Zoonosis refers to infectious diseases that can be transmitted from non-human animals to humans.¹⁸ For the sake of completeness, it also refers to infectious diseases that can be transferred from humans to non-human animals, a

process sometimes called reverse zoonosis, which won't be further discussed except to say it can lead to a decrease in certain animals important for ecotourism.

Ebola is a zoonotic disease, transmitted from infected monkeys or humans to healthy individuals. Though relatively rare its high morbidity rate, approximately 50 to 89% of people who contract it die, as well as the manner in which it causes death, uncontrollable massive internal and external hemorrhaging, has made it extremely well known.¹⁹ Named for the site of the first recognized outbreak, the Ebola River Valley in the Democratic Republic of the Congo (then called the Republic of Zaire), the chance of it being spread through contact is so great that it is classified as a Biosafety Level-4 pathogen, requiring the strictest safety precautions for laboratory investigation. Even death of the victim does not end the danger of it being transmitted, for the body fluids remain contagious, as described below regarding Mabalo Lokela, a schoolteacher in Zaire, who arrived in late August to a mission hospital with a fever, treated for what was thought to be malaria, and returned a week later even sicker. The good Sisters did all they could for him as he started to bleed. He died on September 8, 1976, and his body was washed and prepared for a traditional funeral, but that is not where the story ends.

Not long afterwards , many members of his family and friends who had attended the ceremony succumbed to the same symptoms and several of the staff at the mission hospital became desperately ill. Panic broke out: it seemed as if people were literally bleeding to death. The mission hospital at Yambuku was eventually closed on 30 September, and the whole area sealed off by the Zairian army.²⁰

Eventually the disease would spread to more than 50 villages in the area of Yambuku. Even Kinshasa, the capital of Zaire, was not to be spared. When the epidemiologists did their counting they discovered there had been a total of 318 cases, of which 280 died, resulting in a staggering mortality rate of nearly 90 per cent.²¹

There is more than just a medical component in deploying troops into an area where hemorrhagic fevers such as Ebola may be present; there is a psychological component as well. Depicted in the media as something so gruesome it could be from a science fiction novel, and extremely contagious, troops may be unwilling to touch local villagers even when they approach the soldiers in a friendly manner. “Who knows if this smiling healthy villager today won’t be bleeding from every possible orifice next week? Is it worth the risk to be in the same condition just to shake his hand?” Surely winning hearts and minds will be more difficult in such a scenario, especially if a soldier should shoot a smiling villager approaching him with outstretched arms.

Before leaving this section it's important to discuss one more medical issue which may impact military operations in Africa. As previously mentioned, much has been said about the spread of malaria, however, very little has been discussed regarding the complications of the antimalarial medications soldiers would be taking who deploy to these areas. Depending on which drug soldiers use, adverse effects could include diarrhea, blurred vision, nightmares, depression, anxiety, photosensitivity, and other problems.²² While most adverse effects are relatively mild and/or short lived, and some can readily be eliminated by switching medications, when present they can degrade the operational capabilities of soldiers.

Political and Religious Issues

Concerns of nations disproportionately impacted by global warming and/or lacking the resources to mitigate the adverse effects may lead to interesting political alignments that could have military implications. Thus, small island nations at risk of inundation may form a voting bloc at the United Nations, willing to give their stamp of approval to almost any country or cause in exchange for proposed action to lessen the impact global warming will have on their nations.

Though much has been said about the potential for conflict among poorer nations impacted by global warming, as they fight over increasingly scarce resources, significantly less has been mentioned regarding the growing anger of their people against the main culprits, the US, China, and other large greenhouse gas producers. On the streets of Kampala, Praia, or Stone Harbor there is a growing sense of betrayal by their wealthier brethren. How could the rich countries let global warming happen, and, in fact, continue to let the situation get worse? As the level of antagonism towards developed countries rises, so does the likelihood of broken treaties, diplomatic clashes, and even ecoterrorism.

Perhaps more ominous is the likelihood there will be a rise in religious fanaticism. The failure of modern science to cure the problem, in fact, the responsibility of science for at least being partially the cause of global warming, may turn people to religion for answers. Farmers praying for rain during a prolonged drought do not portend any difficulties; farmers looking for the cause of their drought and finding it's because their society tolerates homosexuals or allows a small, nearby tribe to pray to a different God than theirs is a significant danger. It's a recipe for ethnic cleansing. Killing that tribe removes

the abomination of fraudulent religious practices and, as a benefit, decreases resource scarcity for the ones who did the killing.

Such religious zeal in response to global warming is not so far-fetched. Religious conservatism is a growing trend in many parts of the world. Also, traditionally “control over nature,” be it praying for rains to end the drought or the rains to end in order to stop the floods, has been and continues to be an integral practice of many religions. “The temperature is rising, the lake is drying, the crops are withering...it must be divine intervention. God is punishing us for a great sin and the only way to restore the balance in nature is to restore our balance with God, which means removing the cause of His anger.” Whether it’s the small tribe down the road who prays to statues or the Americans in Africa whose liberal ways were considered religiously offensive even before global warming occurred, someone will pay, and they will pay in blood.

Adding to the problem will be the attempt by developed countries to limit less developed countries in both the production of greenhouse gases and the clearing of forests which absorb these gases. Regarding the former, the production of gases, less developed countries presently argue it is unfair to restrict their growth as it is punishing them for a problem they did not create. For over a century developed countries had major industries and a significant number of cars which spewed carbon dioxide into the atmosphere. Most of Africa during that time had far less of these, so arguably it should be also be allowed to develop economies based on fossil fuels. To place restrictions on the number and/or type of factories they install might be considered imperialism and/or neocolonialism.

Similar arguments can be made for the clearing of forests. It is African land, and for nations outside of Africa to do anything stronger than encourage the trees be spared is to deny the rights of African nations to choose their own development paths. Once again, even well-intentioned attempts by developed countries to mitigate global warming through influencing African policies will likely result in accusations of unwelcomed foreign mingling.

The ramifications of “attitude adjustments” on the part of African nations in response to pressure regarding fossil-fuel and forest use from America and other wealthy nations may include resentment against American military forces, especially as the local populace watches television and sees Americans driving gas guzzling cars. US troops, while thinking they are in Africa for a good cause, may suddenly find themselves under attack from crowds angry at what they perceive to be a paternalistic, neocolonial, hypocritical America.

Will Al Qaeda Fill Voids Left by Government?

As tax revenues decrease from drops in crop exports and ecotourism, government expenses will increase at the same time in order to mitigate the effects, such as lack of food and mass human migrations, caused by global warming. Thus, African governments already strained to provide basic services now will likely fall further behind with the added burden of rising temperatures. Filling the void created by this mismatch between needs and government capabilities may be terrorist organizations, or at least what the US considers to be terrorist organizations, for if they provide security when there are no local police, schools when there are no government paid teachers, and healthcare when there

are no government doctors and nurses, then the local populace is more likely to look upon them as saviors rather than terrorists.

Al Qaeda is already present in parts of Africa, and while some regions may resist branches of this group being established in their territories, others may welcome it. Al Qaeda will probably take advantage not only of voids created by African governments; it will also be there when tensions between Muslims and Christians are exacerbated as food shortages from global warming hit the continent. In the end, should African or American troops intervene to attempt to restore order between the warring parties, the soldiers might find IED's and other signs of Al Qaeda's presence where just a few years earlier there had been none. Global warming might mean global jihad.

The Genocide Question

To many analysts the genocide in Darfur is a result from environmental degradation. As the northerners in that region of Sudan overgrazed the land, they pushed farther south where the population traditionally were agriculturists. Fighting ensued. Eventually the northerners received help from the Sudanese government and the Janjaweed, as the northerners are called, set about to eliminate the southerners. Other than a weak African Union response, there was essentially no military intervention to stop this genocide.²³

Global warming is going to cause environmental degradation and with it, human migrations, just as the northerners in Darfur entered the southerner's territory. As one group of people enters the territory of another, ethnic cleansing is a distinct possibility. From a military operations standpoint there are several factors to consider should Americans contemplate intervention

- It might not always be easy to tell who is the enemy for in some instances both sides could have blood on their hands.
- Short term attempts to relieve hunger and other problems caused by global warming could result in long term refugee camps as the decrease in fertile farmland means less resources for the Africans to feed themselves.
- There could be no visible endpoint for certain interventions. Should American troops intervene to keep warring parties separate, with the underlying conditions that created the situation unremediated and perhaps unremediable, a bloodbath could occur if the US pulled out.

Is America ready to sit militarily on the sidelines as it did during the Rwanda genocide and the ongoing genocide in Darfur? Is it willing to put its soldiers in harm's way to prevent or stop killings in a continent that has had endless conflicts? As global warming degrades the environment additional instances of ethnic cleansing will likely arise. If the first decision of military operations is whether or not to commit troops, America will have a great deal of soul searching to do in the years to come.

Diversion of Soldiers

Mitigating the effects of global warming in Africa will probably involve the diversion of that continent's soldiers from what could be thought of as normal defense functions. Instead of practicing on the rifle range they will be constructing irrigation canals, instead of learning small unit tactics they will be extinguishing fires, and instead of holding joint training exercises with the Americans they will be constructing levees to protect against

flooding. The reader is reminded of an earlier part of the paper discussing how Zairian troops were used during an outbreak of Ebola in 1976; they sealed off an entire region around the epicenter to halt its spread. With a possible increase of deadly communicable diseases in the future, it's quite likely troops, African and perhaps American, will be called upon to implement public health measures, diverting them from their usual duties.

Another casualty of politicians' preoccupation of using soldiers to combat global climate change within their own countries might be their unwillingness to share these troops for peacekeeping missions elsewhere. Already suffering decreased troop levels because of lost tax revenue, they will prevent the remaining forces from being sent to distant lands, sequestering them instead for domestic purposes.

Weaker Allied Soldiers

As global warming increases, America's allied soldiers in Africa will find it more difficult to fight not just because of the well described effects of decreased endurance in warmer weather but because of possible nutritional deficiencies. There are two reasons for this: less total food produced and a shift to less nutritious staples being grown. Regarding the first, less total food produced, as global warming dries out previously fertile lands in Africa, fewer crops can be raised. African soldiers may have to share in the shortages, thus eating fewer calories than required to maintain their health.

The second reason, less nutritional food being raised, is due to farmers choosing crops that are more heat resistant but possibly have less vitamins and minerals. Additionally, some traditional crops might still be capable of being raised on dried soil but don't absorb as many nutrients in comparison to those being raised in moister ground.

The end result is less healthy food available for African soldiers. Thus, the endurance problem of working in the heat will be compounded by the fact the workers, soldiers, might have poor nutrition.

It would be remiss not to discuss some of the American soldiers who will have a problem with the heat also related to nutrition, they are overweight. While many US soldiers are fit and readily meet weight standards, some are towards the heavier side. That extra weight acts as insulation, trapping body heat, so they will have an increasingly harder time coping in an increasingly hotter environment.²⁴

An Increased Likelihood of Encountering Wind Farms and Solar Stations During Conflict

Part of the response to global warming has been to increase the number of windmill farms and solar power stations in order to decrease the amount of fossil fuel burned, fossil fuel which releases the greenhouse gas carbon dioxide during combustion. Additionally, with the rising cost of oil and gas, harnessing the wind and sun can make good economic sense. However, with the proliferation of windmill farms and solar power stations comes the increased likelihood they will be targeted, either deliberately or accidentally, during conflict.

It wouldn't take much to knock a solar panel out of commission. Ones manufactured in the United States to meet safety certifications UL 1703 or IEC 61730 are surprisingly durable when it comes to the weather. Their glass is tempered and in many cases has been designed to survive one inch hail striking it at 50 miles per hour.²⁵ However, mortars are not hail, and explosive devices could readily shatter the solar panels. Besides,

many of the solar panels in Africa were not made in the United States and thus don't even meet the durability requirements against extreme weather.

The undersides of solar panels are particularly vulnerable. These are provided with little to no protection as they are not expected to be exposed to inclement weather. Thus, while the top part of the panel affords at least some protection as it's covered with a pane of tempered glass, it would take even less to damage and/or destroy solar panels by attacking their soft underbellies. A terrorist with a few improvised explosive devices could probably cause significant damage in a small solar power station.

Windmills are also vulnerable to attack. It's not necessary to knock them over or remove their blades in order to incapacitate their electricity producing capabilities. A rocket propelled grenade to the gear mechanism would probably be enough to render them useless.

Thus, should the US find itself conducting military operations in Africa in the future it will likely find large numbers of solar panels, and to a lesser extent windmills, constructed in part for economic reasons and in part to decrease emission of some of the greenhouse gases, such as carbon dioxide, responsible for global warming. Should these alternative energy systems be owned by an American ally it might fall upon the US to attempt to protect these high value targets. Should an enemy possess windmills and solar panels the US will have to decide whether or not to destroy them.

It's important to point out that targeting alternative energy systems is not the same, at least from a public relations standpoint, as targeting a diesel generator. Windmills and solar panels, providing electricity without polluting the environment, are thought of as the hope for the future. Destroying them, as opposed to destroying an old diesel generator

that has been spewing forth particle laden smoke, could result in enormous amounts of negative publicity. It's a difficult decision the US could face one day, and it is probably best to prepare for that day now by attempting to fully understand, as much as possible, the possible ramifications of such an action. "America destroys African country's hope for the future by destroying its solar power station" is probably not the type of headline that will bring out international goodwill for the military even if that African country was an enemy. Alternative energy systems may require an alternative strategy.

Dust and Desertification

Unfortunately, with global warming, the amount of dust created will likely accelerate. There are essentially two interrelated reasons for this. First, some soil that is normally moist and doesn't readily crumble will lose part of its water content as the temperature rises. This drying out will result in soil that now readily crumbles, breaking into small particles which the wind can capture. The second reason is with the decline in soil fertility in certain regions, combined with less water available for irrigation, people will increasingly cut down vegetation to bring more land into agricultural production. The result will be moist soil, perhaps good for a few years of crops, before it, too, dries up and blows away, leading farmers to clear even more land, resulting in a never ending cycle where the final product is dried airborne soil...dust.

While particles of dust may be small, the problems they can cause are quite large, especially with regards to combat operations. To begin with, as the concentration of dust increases there is a concomitant increase in certain types of diseases. The meningitis belt of Africa, which extends from Senegal on the west coast to Ethiopia on the east coast, is a

prime example.²⁶ During the dry season in that region there is a tremendous rise in the number of cases of meningitis, a potentially lethal infection of the linings of both the brain and spinal cord, caused by the increase in dust. It is unsure whether the meningitis outbreaks are caused by the dust carrying the pathogenic microbe for meningitis or whether the dust, in eroding an individual's respiratory tract, allows the microbes which may have been already been present on the person entry into the bloodstream where they can now cause the disease. Perhaps it is a combination of both, the dust eroding the respiratory tract as well as bringing the microbe. Whatever the etiology, the result is a very dangerous disease.

Infections are not the only health problem caused by the swirling dust. Asthma attacks can readily be triggered by these tiny but numerous irritants. Additionally, even healthy people find it extremely difficult to breathe when the dust concentrations rise, making combat operations quite difficult.

There are two other problems with dust besides health related ones which impact military operations. Visibility can be greatly decreased and equipment is degraded by the flying particles getting in everywhere there is an opening – be it a jet engine, artillery piece, or rifle.

Speaking of rifles, Africa's ubiquitous weapon, the AK-47, is probably better able to maintain functionality despite the ravages of dust than some more modern weapons. Constructed to looser tolerances than its western counterparts such as the M16, the AK 47 tends to continue firing even if dust particles enter its firing mechanism.²⁷ The AK 47's ruggedness though comes with a tradeoff; it's less accurate than the more precise machined M16.

The increasingly large amounts of dust present are an ominous sign that many parts of Africa are getting drier. However, one doesn't need to look at tiny particles of dust to realize this. Go to a much larger scale, look at satellite images of huge swaths of land that were previously verdant but are now a lifeless yellowish-white, reflecting desertification and deforestation.²⁸ Military ops in such environments might entail large civil affairs-type projects: planting trees, digging wells, and other actions to attempt to mitigate the damage. Should more kinetic actions be necessary it will be important to have updated maps, for the equipment and training to fight in a desert is different than for a tropical rainforest, even if that desert had been a tropical rainforest not too long ago.

Don't Expect Mitigated Facilities

Though America will be able to mitigate some of the problems within the US caused by global warming, African nations, lacking the financial and technical resources, will most likely be unable to do the same. Therefore, should Americans need to utilize African facilities for military operations, some of them may fall considerably short of what is needed and/or expected. Here are some possible examples:

- As the temperature increases jets need longer runways for takeoff. Many African airports are already woefully short both physically and of funds. Should longer runways be required for military ops it's doubtful some African nations will be able to meet the new requirements.
- Many African barracks and training facilities are already quite hot. Though American troops are a hardy bunch, it's likely there will be additional cases of

heat exhaustion as the temperature rises and air conditioning remains financially out of the question.

- Updated maps reflecting not just physical geography, such as dried up rivers, but also ethnography, as large groups move in response to environmental degradation, will not be available. Keeping maps current is expensive. US soldiers might find themselves relying on outdated information, a potentially dangerous proposition.
- Port facilities may not have adjusted to the rising water, making on and offloading ships difficult.

Conclusion

The crystal ball is cloudy, or maybe more fittingly, dusty, making precise projections impossible. Will global warming result in significant changes in military operations in Africa, or will the necessary adjustments be relatively minor? Perhaps the most likely scenario is the middle ground: some large adjustments here, some small ones there, and many that fall in-between. At this point the best that can be done is to formulate some reasonable hypotheses based on past history and what appear to be logical assumptions. Unfortunately, maybe some variables that were ignored in formulating predictions turn out to actually be more important than originally anticipated, completely skewing what seemed like such sensible thoughts.

There have already been numerous predictions regarding what might occur in Africa should global warming occur. Malaria and other insect-borne diseases will increase, heat exhaustion will be more common, and mass migrations of people will occur as their farmland becomes infertile. These and other extrapolations are quite important, and help

serve as the basis for many of the projections as to what future military operations might be in Africa. There are, however, less discussed, maybe even overlooked, issues related to global warming and its impact on military operations in Africa. This paper has attempted to describe some of these.

So, with the caveat that nothing is certain, a summary of what the US might reasonably expect to happen in Africa, besides an increased exposure to malaria and a greater likelihood of heat exhaustion, regarding future military ops in Africa is as follows:

- African governments, under pressure from decreasing revenue, will be unable to meet the needs of their militaries. This will result in potential American allies not being as well trained, not having the appropriate equipment, and not participating as much in foreign peacekeeping missions. Instead, much of our potential allies' time might be spent on projects attempting to mitigate the effects of the rising temperature.
- African governments increasingly unable to meet the basic needs of their people, might unwillingly provide openings to groups such as Al Qaeda to fill the voids.
- The resolve to place American troops in certain areas will be tested when outbreaks of diseases such as Ebola, which seems to have come from the pages of a science fiction novel, start to occur.
- Increasing dust will lead to a host of problems such as decreased visibility, degraded weapons' capabilities, and diseases.
- The increasing presence of solar power stations means they will likely be targeted, either deliberately or accidentally, during conflict.

- The potential presence of Chinese in trouble spots, complicating situations as their businessmen, and maybe their troops, need to be considered in any planning for military operations.
- With rising temperatures will likely come increased suffering as well as conflict. America might repeatedly face the tough decision of whether to intervene militarily in Africa for humanitarian reasons. Even ethnic cleansing is no guarantee that it will go in.

It's not only a call to combat ethnic cleaning that might bring American forces into Africa. The United States has important ties to Africa, including increasing reliance on its rare earth minerals, critical to electronics. Still, it's a continent known for its conflicts, so wary of entanglements and still drained from fighting two wars, the American military may protect those ties with a minimum amount of force. In other words, military operations quite limited in scope might be the norm. If American troops have to go in, planners of the military operations will need to remember that with global warming, it is not just soldiering in a hotter environment; there are many less discussed issues which also need to be addressed.

Disclaimer

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Notes

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